

Supportability Optimization to Achieve Availability Goals in Acquisitions

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Achieving a System Operational Availability Requirement (ASOAR) Model

- **Optimally Allocates System Ao to an End Item Ao goal for the End Item Being Acquired**
 - **Integrated Macro-Level RAM and Supportability Analysis to Help Generate Early-On Requirements**
 - **Considers End Item Redundancy and Floats, Periodic Maintenance Actions, and Reliability of Other End Items In System in Ao Goal**
- **Determines Ao Inputs to Use in Supportability Optimization Models**
- **Drawback - Today Only DCSOPS Systems Analysis can Run ASOAR**

System Supportability Optimization Modeling to Operational Availability

SYSTEM A_o / READINESS RATE REQUIREMENT

**OPTIMAL ALLOCATION OF
OPERATIONAL AVAILABILITY
(A_o)**

ASOAR

END ITEM A_o GOAL

**MAINTENANCE
OPTIMIZATION**

COMPASS

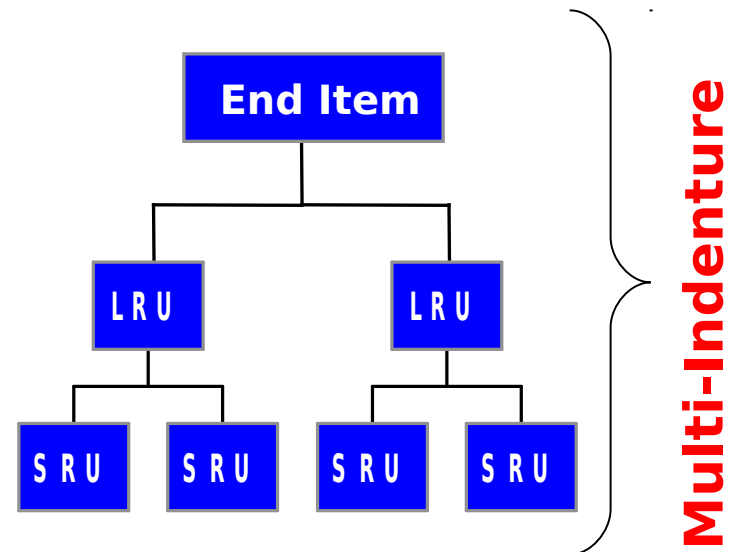
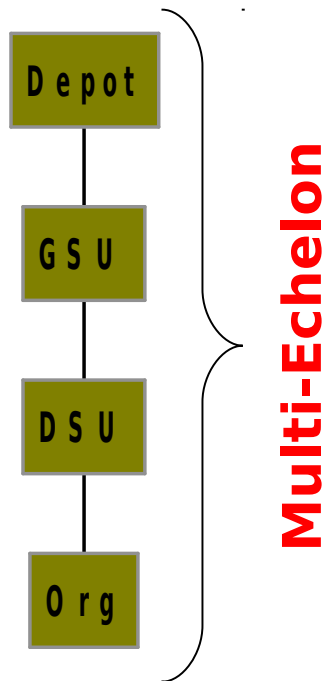
**SUPPLY
OPTIMIZATION**

SESAME

**LEAST COST MAINTENANCE
CONCEPT FOR LRUs & SRUs**

**LEAST COST SPARING
MIX FOR LRUs & SRUs**

Logistics Chain Support Effectiveness Optimization



Sparing to Availability Concept Optimization Heuristic

- **LRU Cost to Failure Rate to Down Time Ratios Without LRU Spares are Compared ($\text{COST} \times \text{MCTBF} / \text{CWT}$)**
- **LRUs with Lowest Ratios are Spared Forward First**
- **Sparring Lowers CWT to Increase Ratio for Next Spare**
- **The LRU Sparring Increase Stops When the Product of LRU Availabilities Equal the End Item Ao Target**
- **LRUs with a Ratio Higher Than the Final Ratio Meeting the Ao Target Will Not be Spared**

Sparing Optimization Example

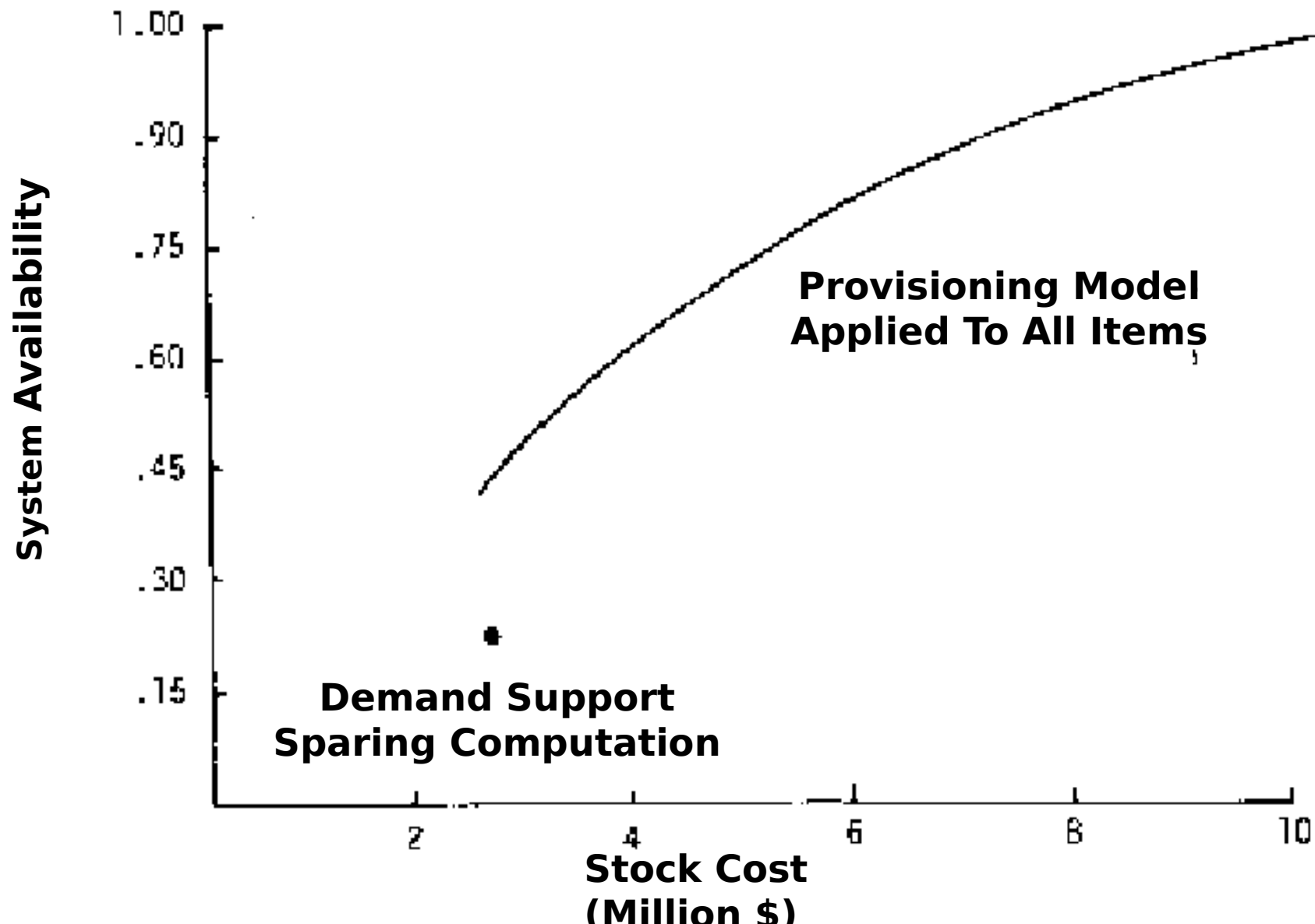
GIVEN:

- **LRU2 COSTS 20 TIMES MORE THAN LRU1**
- **LRU2 HAS TWICE THE FAILURE RATE OF LRU1**
- **WITHOUT SPARES, THEIR CUSTOMER WAIT TIMES ARE SIMILAR**

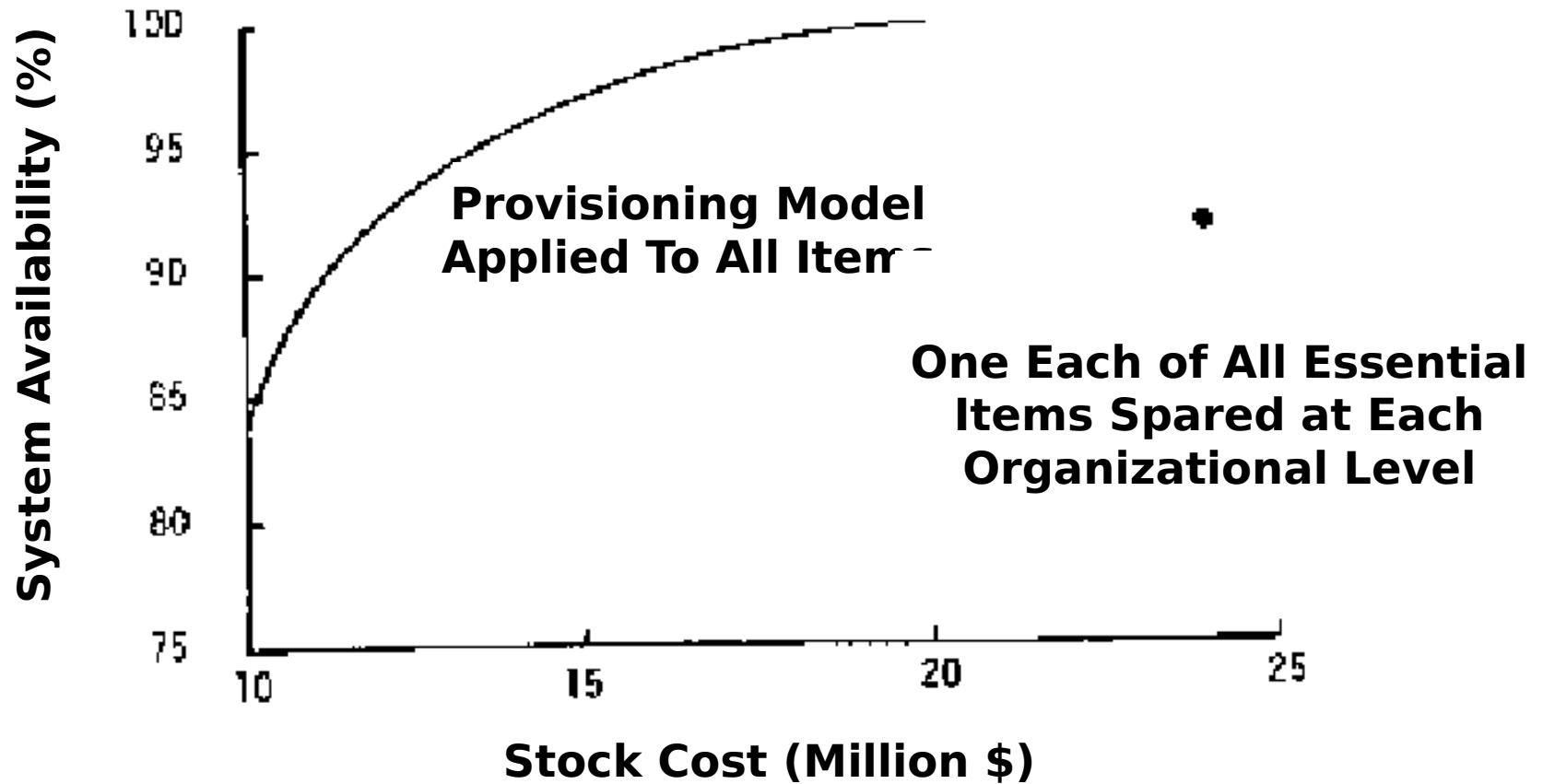
CONCLUSION:

- **DUE TO HALF THE FAILURE FREQUENCY AND EQUAL DOWN TIME PER FAILURE, LRU1 IS HALF AS IMPORTANT FOR REDUCING DOWN TIME**
- **SINCE LRU1 COSTS 20 TIMES LESS, THE FIRST SPARE OF LRU1 YIELDS APPROXIMATELY 10 TIMES LESS COST PER UNIT REDUCTION OF SYSTEM DOWN TIME ($1/2 \times 20 = 10$)**
- **ALTHOUGH LRU2 FAILS MORE, IT IS LESS COST EFFECTIVE TO SPARE**
- **IF THE CWT ASSOCIATED TO LRU2 WERE 10 TIMES GREATER THAN LRU1, THE SPARING COSTS PER REDUCTION IN SYSTEM DOWN TIME BECOMES APPROXIMATELY EQUAL**

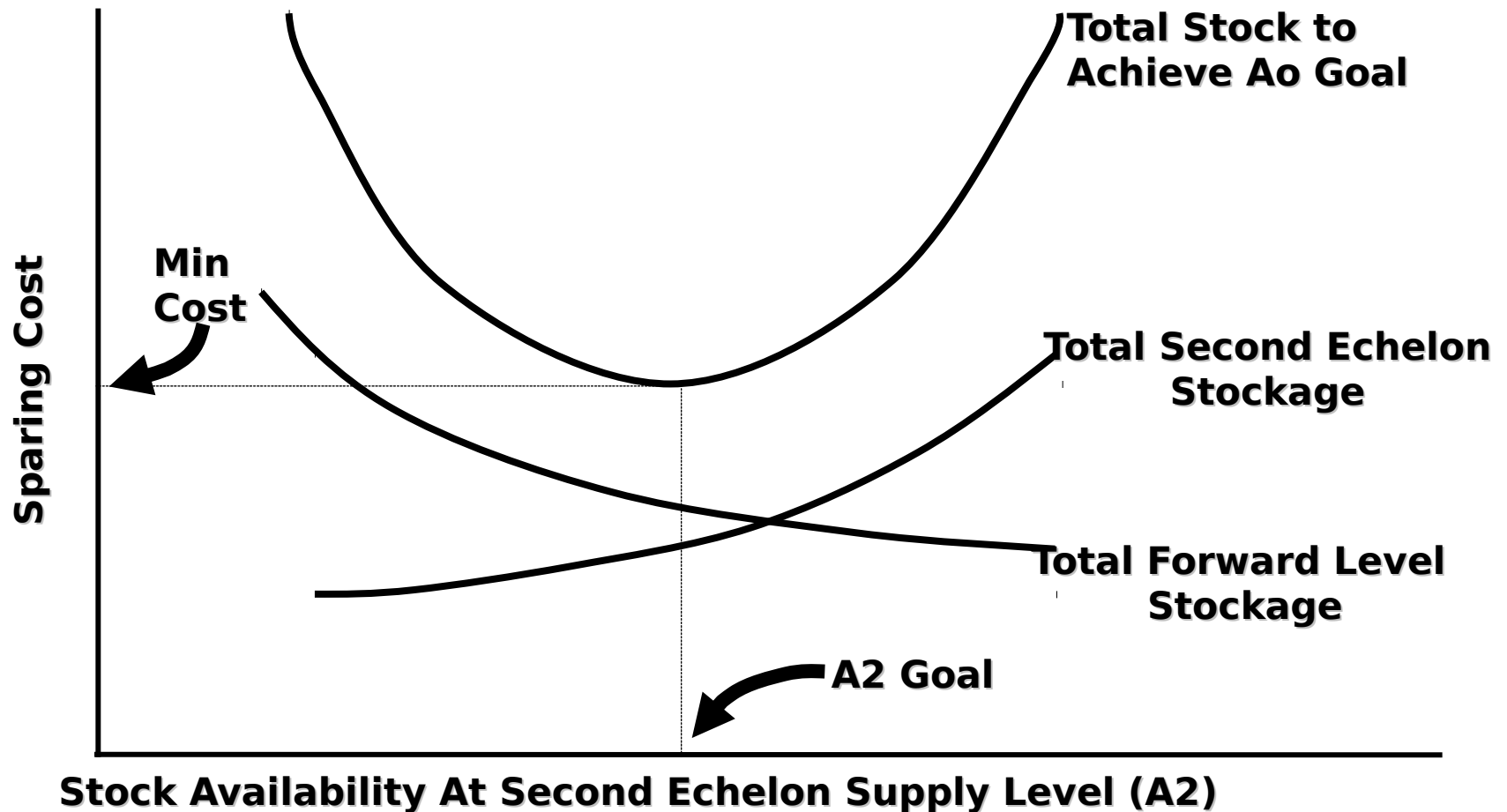
Comparing to Availability vs Demand Support Sparing



Sparing to Availability Is Better than Sparing All Essential LRUs



Multi-Echelon Sparing Optimization to Ao Requirement



SESAME

Selected Essential-item Stock to Availability Method

- **Supply Chain Mission is to Support Operational Readiness & Performance**
- **Emphasis on Budgeting & Stocking to Achieve System Ao Performance Goals at Least Cost**
- **Decision Support Tool with Cost as a Major Factor in Sparing to Reduce Risk of Procuring Wrong Parts**
- **Identifies Initial Provisioning Requirements Prior to Production**

SESAME Usefulness

- **Optimizes Multi-Echelon Retail Level Initial Sparing to Achieve End Item Ao Requirement or a Procurement \$, Weight or Volume Goal**
-OR-
- **Optimizes Plus Up Sparing to Achieve End Item Ao Given the Present Retail Level Sparing Mix**
-OR-
- **Evaluates End Item Ao Based on Sparing Mix, LRU Reliabilities and Logistics Response Times**

Maintenance Concept for each Essential Item is Proposed or Known

SESAME Execution Modes



Decision
Support
Tools

“How much should I budget to meet my A_0 target?”

Operational Performance Optimization:

- Determine Least Cost Mix of Spares

that will meet Target A_0

Budget Constraint Optimization:

Determine maximum A_0 that can be achieved given a fixed spares budget

“How much A_0 can I buy with my budget?”

“How good is the contractor’s recommendation?”

Evaluation:

- Evaluate Stock Levels in terms of A_0
 - Existing stock in inventory
 - Vendor Recommendation

Plus-Up:

- Augment Existing Stock Levels
 - to meet Target A_0
 - Optimal increase

“Given that my stock levels won’t meet my A_0 target, How should I augment them?”

SESAME Outputs

- **Summary Data:**
 - **Ao vs. \$ Graph and Table**
 - **Budget at Each Retail Support Echelon**
 - **Budget Requirement by Year**
 - **Initial Retail Support Spares**
 - **Depot Pipeline Spares**
 - **Consumption Spares**
- **Sparing for Each Unit at Each Echelon:**
 - **Stock Quantities of Each Item**
 - **Item Cost Contributions**

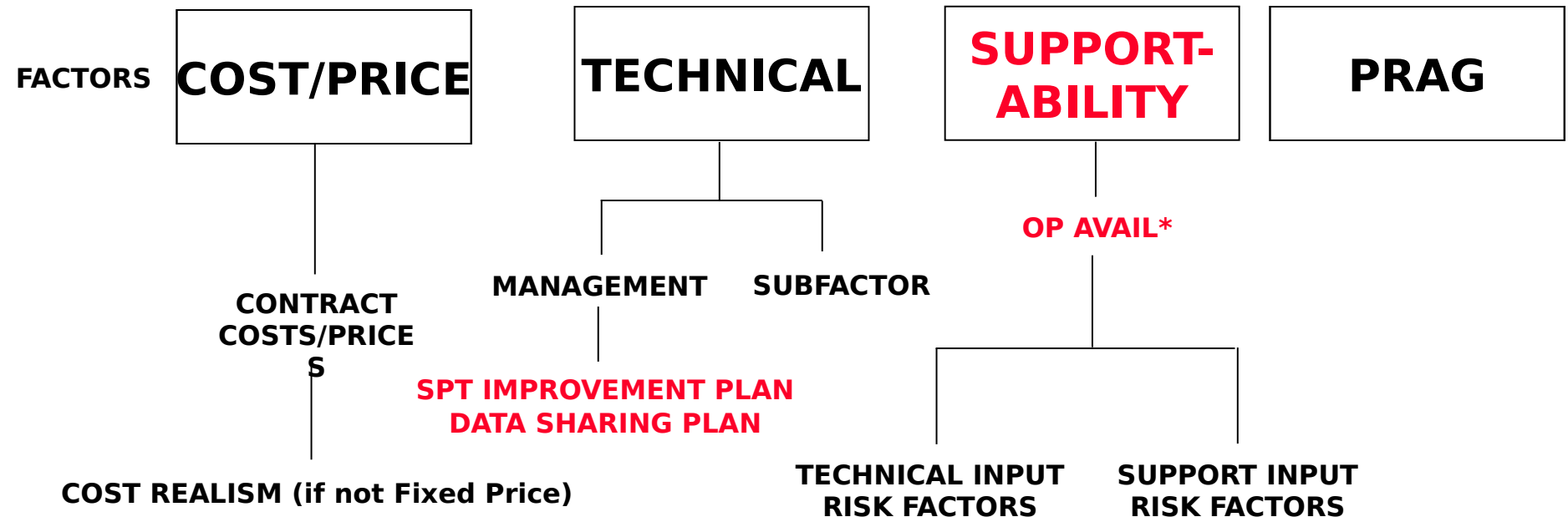
End Item Level Inputs

- **Ao or \$ Goal to Optimize -or- LRU Sparing Mix to Evaluate Ao**
- **End Item MCTBF** (*Applies only when not computed by the addition of serially configured LRU failure rates*)
- **Number of End Items Fielded Each Year for Each Forward Support Level (Org or DS Unit may be Lowest Level modeled)**
- **Number of Lower Level Units Supported by Higher Level Unit**
 - **For 2 level supply, Org or DS level and GS Level do not apply**
 - **For 3 level supply, Org or GS Level do not apply**
- **Number of Clones Each Year for Each Applicable Unit**
 - **Copies with same number of end items & Support**

Critical LRU Level Inputs

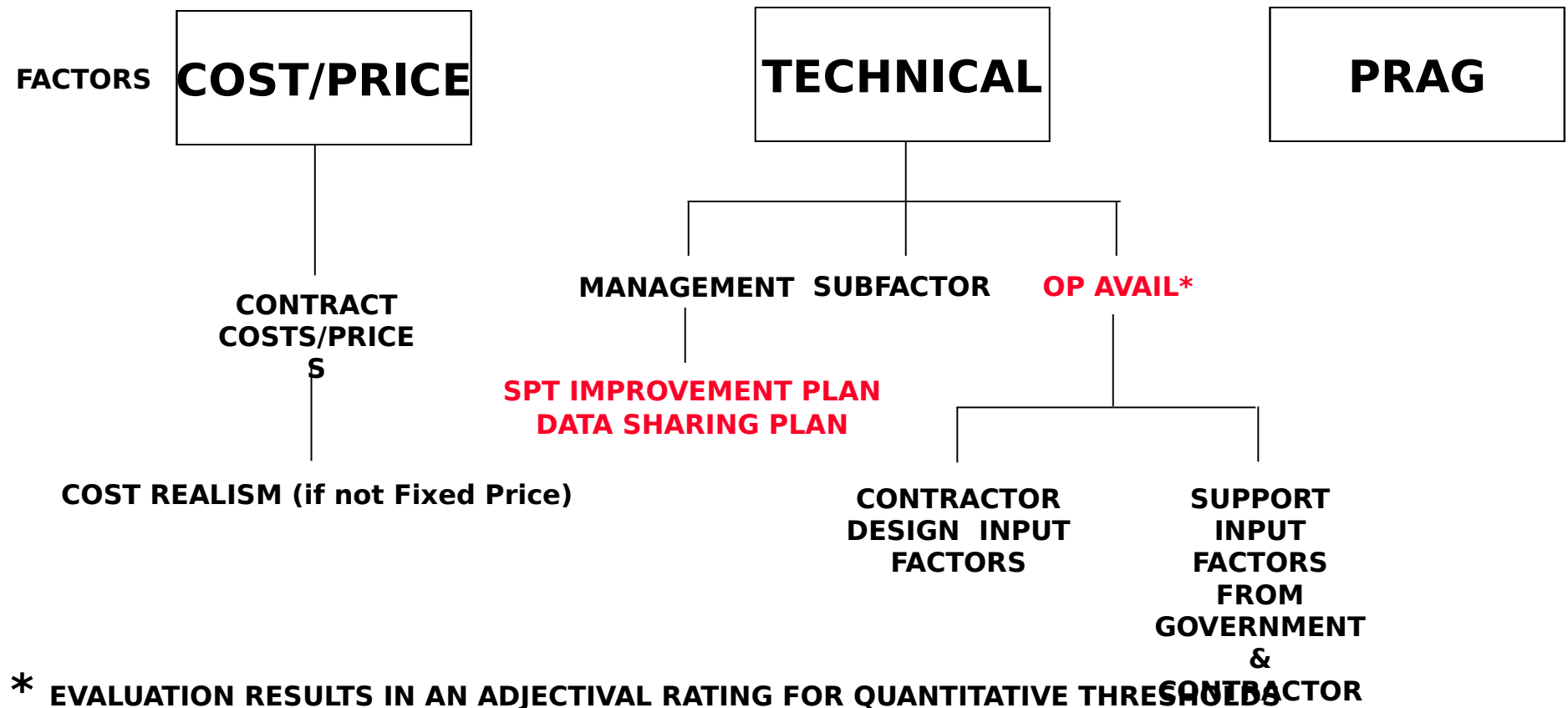
- **Average Maintenance Time Parameters**
 - **Time to Restore End Item if Spares in PLL, or ASL when no PLL**
 - **Repair Cycle Time (Retrograde Ship Time + Turnaround Time)**
- **Average Supply System Parameters**
 - **Order & Ship Times to PLL and to ASL by Theater**
 - **Wholesale/Depot Level LRU Stock Availability**
 - **Time for Wholesale/Depot Level to Fill Backorders**
- **Data Needed for Each LRU**
 - **Failure Factors (Annual Removals per 100 End Item)**
 - **Average Procurement Cost**
 - **Minimum Guaranteed % of Total Annual Demand**

Evaluation Plan with Supportability in Competitive Solicitations



* EVALUATION RESULTS IN AN ADJECTIVAL RATING FOR QUANTITATIVE THRESHOLDS

Optional Evaluation Plan with Supportability



COMPASS Usefulness

- **Optimizes Maintenance Concepts (Level of Repair Analysis) to Achieve an End Item Ao/Readiness Requirement at Lowest Total Support Cost**
- **Compares Similar Maintenance Level Alternatives (Source of Repair Analysis) for Best Value**
- **Evaluates Design Breakdown Impacts to RAM Related Logistics Support Costs**

Supply Sparing Mix Optimization to End Item Ao is Embedded

Model Objective

**Maintenance
(TMDE, etc.)**

**Supply
Support
(S. res)**



**Level of Repair
Decisions**

**Source of Repair
Decisions**

COMPASS Outputs

- **Maintenance Policy**
 - **Where:**
 - **Org, Intermediate, Depot, Contractor, Discard**
 - **How:**
 - **ATE, Common TMDE, Special TMDE**
- **Initial Provisioning**
- **Net Present Value Costs**



Net Present Value Costs Estimated

- **Initial Provisioning**
- **Consumption
(Replenishment) Spares**
- **Inventory Holding**
- **Transportation
(Shipping spares back
and forth)**
- **Requisition**
- **Cataloging**
- **Enter and maintain line
on PLL/ASL**
- **Common Labor**
- **Screening**
- **Documentation**
- **Test Program Set
Development &
Maintenance**
- **Contractor**
 - **Variable per repair costs**
 - **Fixed costs**
- **Contact Team**
- **Common Test Equipment**
- **Special Test Equipment**
- **Special Repairmen**

End Item Level Inputs

- **A₀ Target** & *Maintenance Concept if not optimized*
- **Total Number of Systems Fielded**
- **Operating Hours per Year** & **MTBF** if not computed
- **Support Structure**
 - **Number of Sites at Each Maintenance Level**
 - **Order and Ship Times to Each Retail Support Level**
 - **MTTR** & **Restoral Time if DS is forward supply**
- **General Cost Parameters**
 - **Shipping**
 - **Cataloging, Bin, Inventory Holding Cost %**

Typically a Contractor Input

Typically a Government Input

Input may come from Government or Contractor

LRU/SRU Level Inputs

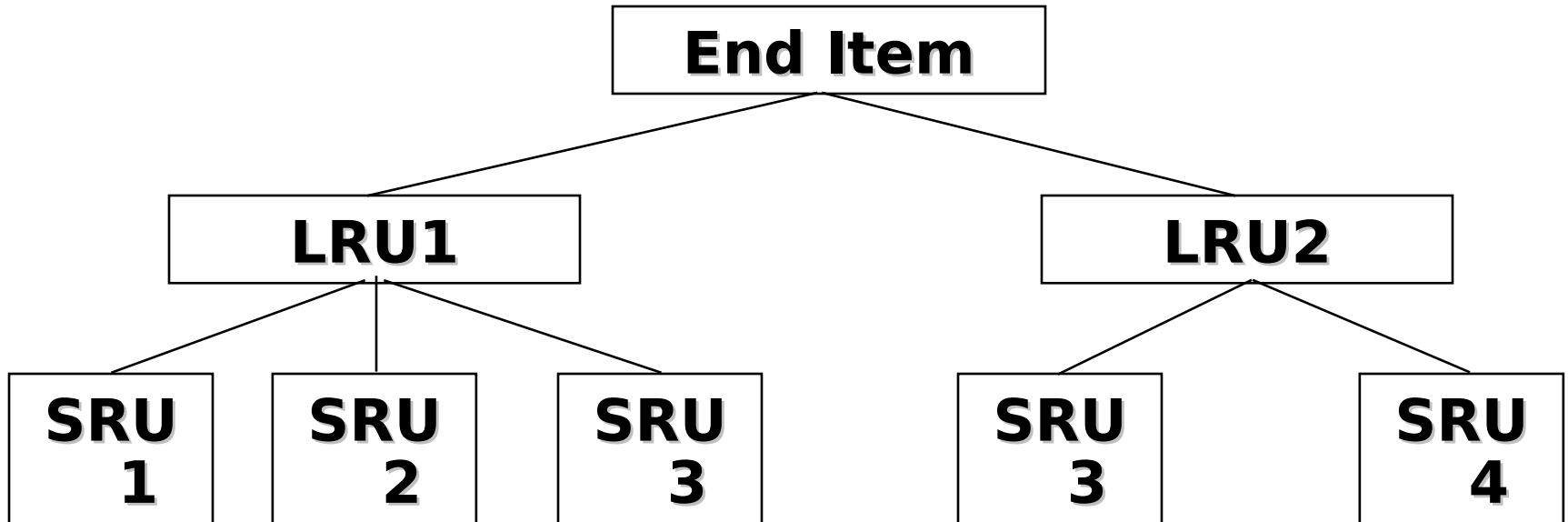
- **Hardware**
 - **Failure Rate**
 - **False Pull Rate**
 - **Unit Price**
 - **Washout Rate**
- **Repair & Screening to Replenish Stock**
 - **Turnaround Time**
 - **Labor Time**
 - **Labor Rate**
 - **Material Cost**
 - **Support Equipment/TPS**
 - **Tech Manual Cost**
- **Contractor Repair if Repair & Return Used**
 - **Setup Costs**
 - **Response Time**
 - **Cost per Repair**
 - **Cost per False Pull**

Typically a Contractor Input

Typically a Government Input

Input may come from Government or Contractor

Equipment Breakdown



Failure Mode 1: LRU1—SRU1

Failure Mode 2: LRU1—SRU2

Failure Mode 3: LRU1—SRU3

Failure Mode 4: LRU2—SRU3

Failure Mode 5: LRU2—SRU4

Use of Models Optimizing to Ao Requirements/Goals

FIELD OR TEST DATA
EVALUATION
OPTIMUM EVAL SUPPORT PRIOR TO
FIELDING
SOURCE SELECTION EVAL WITH LRU DATA
RAM REQUIREMENTS
EVALUATION

ASOAR	✓		✓	
SESAME - EVALUATION MODE		✓		✓
SESAME - OPTIMIZATION MODE		✓	✓	✓
COMPASS - EVALUATION MODE		✓		
COMPASS - OPTIMIZATION MODE		✓	✓	

✓ - Applicable Tool
Supplemental Tool

✓ -